XXXIII.—*On a Point in the Mechanism of the Bill in Birds.*

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It is a well-known fact that very many birds possess the power of raising the upper jaw, though in varying degrees of freedom, depending upon its general conformation and upon the nature of the articulation with the frontal bones. Thus in the Parrots, which are remarkable for the facility with which the upper jaw is raised, we have a fronto-nasal hinge, whilst, more generally, the same end is obtained by slender and flexible premaxillary nasal processes, which overlap the frontal bones.

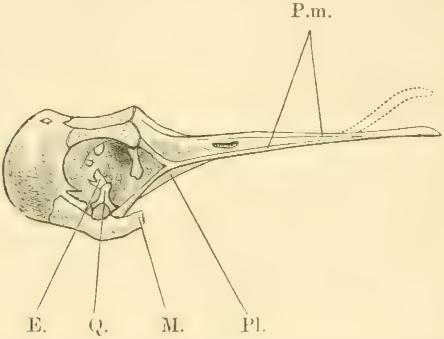
In every case which has been recorded up till now, however, the upper jaw has been moved bodily, but in the case I am about to describe the *distal extremity* only is raised.

Some two years ago, a live Dunlin (*Tringa alpina*, Linn.) was given me, which I endeavoured to keep as long as possible, in the hope of learning something of its life-history. In this I was only partially successful, for the bird lived but a few days—during which time, however, I imagined, on two or three occasions, that I detected an upward turning of the tip of the upper jaw, apparently accompanied by a very human-like gape; nevertheless, owing to the speed and unexpectedness of the action, I failed to satisfy myself that I was not mistaken.

During the Christmas holidays I paid a short visit with my brother to Breydon Water, Great Yarmouth, for the purpose of obtaining specimens. Dunlins were exceedingly numerous and we bagged several; amongst these were two wounded birds, which I undertook to kill, hoping that I might now set at rest my suspicions of other days.

In both cases, in the spasmodic contractions preceding death, the tip of the beak was distinctly curved upwards; but, in the anxiety of watching for this particular movement, I quite forgot to notice whether it was correlated with the opening of the mouth or not, although in all probability it was.

On my return to Oxford, I dissected the head of one of these birds and found, as I expected, that the movement was due—and I think mainly—to the action of the muscles attached to the quadrate and pterygoid bones. I have no doubt that the majority of the readers of 'The Ibis' will readily call to mind the muscles to which I refer, but for the sake of those who may not—for we are not all ornithotomists—I may perhaps be excused if I briefly describe them.



View of the right side of the head of a Dunlin (*Tringa alpina*, L.), showing, by the dotted lines, how the bill curves upwards as a result of the contraction of the muscles described on p. 363. Only one of these muscles is seen, the other being concealed by the quadrate bone and the entotympanicus.

E. Entotympanicus; Q. Quadrate; M. Mandible cut short; P.m. Premaxilla; Pl. Palatine.

These muscles are two in number. The one (E.) arises from the basisphenoid below the optic foramen, and is inserted into the upper border of the orbital process of the quadrate bone (Q.); the other (which is not shown in the figure) arises from the inferior border of the orbital septum and the rostrum of the basisphenoid, and, its fibres converging, is inserted, as a slender tendon, into the upper border of the proximal end of the pterygoid.

These two muscles are described by Dr. Gadow * as a part of the *musculus temporalis*, which, according to this author, is composed of five parts, to the fifth of which the muscles in question belong; further than this, however, they are not specially distinguished. They have nevertheless been named independently and by several writers, each of whom has bestowed a different name upon them. This fact tends to confuse the subject not a little. As a case in point I may mention that both Owen and Dr. Shufeldt have given the name of entotympanic to each of the muscles now under discussion, yet neither had the same muscle in view. Owen's entotympanic (or entotympanicus, to be quite correct) is that which runs from the basisphenoid to the quadrate, or "tympanic" as he calls it, whilst that of Dr. Shufeldt runs from the orbital septum to the pterygoid *.

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* See works of reference cited at the end of this paper.

In order to understand how this particular movement is brought about, it is necessary to bear in mind that the distal end of the quadrate articulates on its outer side with the quadrato-jugal bar, on its inner with the pterygoid, and that this in turn (the pterygoid) articulates with the palatine (Pl.), the distal end of which, together with that of the quadrato-jugal, joins the premaxillary bones. Now, on the contraction of the muscles in question, the quadrate and pterygoid bones are thrust forwards, and with them all the bones opposed to them in front; at the trifurcation of the premaxilla the weakest point is reached, and the remainder of the beak curves upwards. In ordinary birds under similar conditions this point (the weakest) would be at the frontonasal articulation, and consequently the whole jaw would be raised, instead of the tip only. Perhaps a reference to the figure given herewith (p. 362) will assist in making these details clearer.

Prof. Huxley attributes the raising of the upper jaw to the contraction of the digastric muscle †, considering that on the opening of the mouth the quadrate would be thrust forwards, and thus it will be noted the same movements will be set up as those which I have described. I cannot but think, though, that this muscle plays a secondary part in the system.

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* Dr. Shufeldt is describing the myology of the head of the Raven, where this muscle gives off a tendinous slip to the distal end of the quadrate.

† This is apparently equivalent to the human digastric, and the biventer maxillæ of Gadow, Shufeldt, and Owen.

At first sight, perhaps, the reasons for this interesting arrangement may seem rather obscure, but it has struck me that really it may be of importance to birds which gain the greater part of their food by probing in soft mud. I imagine that the beak is thrust down into the soil closed, and that, in all probability, unless some special provision were made, the slender bill would be powerless to force away the surrounding earth sufficiently to enable it to grasp the food it was in search of. Whether or not this is the correct explanation is a subject for further observation.

It may be interesting to know that if the head of a freshly-killed bird, or one preserved in spirit, be gently squeezed in the region of the angle of the mandible, the movements described will be set up.

I hope to be enabled to extend my observations to the other members of the Scolopacidæ, amongst which I expect to find some noteworthy modifications of this interesting feature; should anything of sufficient importance be discovered, I shall be pleased to communicate particulars in these pages. Those having access to the Zoological Gardens have, I imagine, a splendid opportunity for verifying my statements, and I hope this will be done.

In conclusion, let me say that I by no means profess to have exhausted the literature of this subject or to have gone deeply into the inquiry; time must show whether it is worth further attention. All that I have done now is to bring the fact under the notice of those who have time and opportunity, trusting that it will be of sufficient interest to tempt them to add it to their list of things "when found to be made a note of."

References.

1. Owen. Anatomy of Vertebrates, ii. p. 94 (1866).
2. Huxley. Anatomy of Vertebrated Animals, p. 246 (1871).
3. Wiedersheim. Elements of Comparative Anatomy (English translation), p. 80 (1886).
4. Shufeldt. Myology of the Raven, p. 19 (1890).
5. Gadow. Bronn's Klassen und Ordnungen des Thier-Reichs, IV. Abtheilung, Aves, Theil i. p. 323 (1886).
6. Mivart. Elements of Ornithology, p. 187 (1892).